No. XVIII.

On Fossil Reliquia of unknown Vegetables in the Coal Strata. By the Rev. Henry Steinhauer.

FOSSIL reliquia of the vegetable kingdom may be conveniently arranged under the four classes of fossil wood (Lithoxylon), fossil fruits (Lithocarpi), fossil leaves (Lithophylli), perhaps also fossil flowers, if such really occur, as has been asserted at Oeningen, and indeterminate reliquia.* The two

* If a fossil reliquium present the form of a fructification or flower, it may be looked upon as determinate, for these parts of the plant contain a distinctive character different from similar parts in other species or at least genera; and are constant to their figure and appearance in every individual of the same species. The impressions of leaves exhibiting their organization are in like manner generally perfectly distinctive, as they determine the species in most instances, and though the genus is not ascertained from them in the Linnean system, yet there is reason to believe that if our knowledge were sufficiently extensive, detailed and precise, we should find the characteristics of every natural genus, or at any rate of every natural family in the leaf as well as in the parts of fructification. The texture of wood, where this is perfectly discernible in a specimen, satisfactorily establishes identity of species, as we are well able to distinguish between the different kinds of wood in general use, and would, were our observations properly applied, be equally able to discover a difference between that of any two trees in the vegetable kingdom. But this does not seem to be the case where we have only external form, for then is the vegetable itself no longer impregnated, bitumenized, or petrified, but a mere representation in which distinctive characteristics may be altogether wanting. We are therefore left to grope our way among a multitude of specimens, classing together such as are simi-

latter of these divisions belong almost exclusively to the carboniferous strata, though a solitary instance of a fossil fern in the white Lias, one of the lower flöetz strata has come to our knowledge, while the two former are sufficiently abundant in many other strata, but very rarely occur in these. Mr. Martin figures some pericarpial remains, which appear to place the matter beyond doubt, that they are found in the coal Sandstone, but we have never been fortunate enough to meet with any, though often deceived by accounts of such, which upon examination proved to be mere fortuitous configurations of argillaceous iron ore. Fossil wood, that is, such as preserves the appearance of its original texture, and not merely the external shape, is also certainly of very rare occurrence in the coal strata, though carbon evidently originating from vegetable matter is extremely frequent. The fossil leaves which have been found in the class of strata or formation just mentioned, are well known to be closely analogous to the family, though different from the recent species of filices, with some few species of verticillate plants, which have been perhaps too precipitately referred to the genera Rubia and Galium. Their variety and extreme elegance early attracted the attention of naturalists. Scheuchzer paid considerable attention to them as appears from his Herbarium Diluvianum, which also serves as an index to his predecessors, and the subject is judiciously resumed by Mr. Parkinson in the first volume of his Organic Remains. Woodward, in his catalogue enumerates several specimens belonging to this division. Luid has a chapter on the subject and figures a few, and from him we learn that Dr. Richardson, of Bierly Hall, in Yorkshire, took considerable pains to investigate these reliquia, so abundant in the immediate neighbourhood of his residence. It is to be

lar, tracing gradations, seeking for analogues and at last often separating what belongs together, and joining incongruities. In such a labyrinth, to err is excusable, for rare indeed is that combination of talent for observation to see every thing, ingenuity of reason to see nothing in vain, and candour of mind to advance no hypothesis but what is supported by arguments founded on observation, which alone can afford a clue to extricate the wanderer.

regretted that we are not in possession of his entire observations, it appearing from the little which is before the public, that he was possessed of considerable ability; there is however reason to apprehend that neither his collection nor his manuscripts are any longer in existence. The most recent work on the subject that has come to our knowledge is "Von Schlottheim ueber die Pflanzen abdruecke."

Such as choose to pursue the subject farther, will probably be interested in knowing that though the nodules of iron-stone generally represent only a fragment of a leaf, yet specimens of argillaceous iron ore are found, but generally thrown into the heap as undeserving notice, exhibiting very perfect indications of the stems of these plants, which are the more valuable as in the impressions on coal Slate, &c. this part is much defaced by pressure. It is also worth observing, that filicites do sometimes occur on the coarse grained grit below the coal beds, in which case, at least in the specimens which we have seen, the substituted matter has been a yellow oxyd of iron, displaying the texture of the leaf very perfectly, whereas, in the nodules of iron-stone, the impression is generally tinged with carbon, attended by pyrites, and not unfrequently by Bitumen and minute crystals of cubic sulphuret of lead.

It is much to be wished that this interesting part of orycto-logy and botany, for which a considerable quantity of crude materials have already been collected, might soon be treated by some naturalist of competent abilities with the scientific precision of which it is both capable and deserving.

The class of reliquia to which this paper is devoted, may be defined to consist of such impressions, casts or petrefactions in the coal strata, as do not belong to the animal kingdom, yet discover no traces of organisation analogous to that of wood, fruits or leaves now known to exist. They are in fact the paradoxes of mineral botany; the hope to unriddle them seems still at a considerable distance, yet every additional observation draws the circle within which the solution lies, closer, and may thus in some degree facilitate the disclosure of the mysterious secret by the hand of future genius. To attempt a classification

farther than by arranging them under the vegetable kingdom, would at present be more liable to lead to error than likely to answer any beneficial purpose. The discrimination of the different species and a correct detail of the peculiarities belonging to each, as far as they have met the eye of the writer, is all that is here aimed at.

Sp. I. PHYTOLITHUS *verrucosus.*

Plate IV. fig. 1, 2, 3, 4, 5, 6. *Martin, Petrificata Derbiensia, Plate* 11, 12 *and* 13*.—*Parkinson, Organic Remains, Vol. I. Plate III. fig.* 1.

The fossil which has received this name from the ingenious author of the Petrificata Derbiensia, is by far the most common, and perhaps the most remarkable of this class. Woodward seems already to have collected numerous specimens, notwithstanding their bulk and comparative unsightliness; (Catalogue of English Fossils, Vol. I. part 2, p. 104. Vol. II. p. 59, &c.) and Mr. Parkinson has exercised considerable though fruitless ingenuity, in elucidating them. It might appear presumptuous, after the labours of men of such distinguished abilities, to obtrude to public notice, any further remarks, had not these authors left abundant room for observat on, which place of abode and inclination have enabled the writer to pursue during a series of several years. Within this period we have collected several hundred specimens, worked many from the bed of clay in which they were imbedded, and examined in quarries, on coalpit hills, among heaps of stone by the road side, and in various other situations, several thousand. The geological situation of this fossil is well known to be the coal strata, in almost all which, as far as the writer is enabled to judge, it is found. Its geographical habitats in these strata may be partly collected from the works already quoted, the specimens more immediately examined were found in the neighbourhood of Fulneck near

Leeds, or in the space included by the towns of Leeds, Otley, Bradford, Halifax, Huddersfield and Wakefield;* but have

* This district is in fact the northern termination of the great continuous coal field of Yorkshire and Derbyshire, and through its whole extent is thickly beset with coalpits and quarries. I regret my inability to give a precise account of the various beds which occur, but those between Leeds and Bradford appear to be such as are immediately incumbent upon the grit; they consist of an alternation of yellow clay shale in various degrees of induration; argillaceous sandstone; the pale blue shale, or slate clay, accompanying the iron-stone and coal, which falls away on exposure to the air into stiff clay; the true black coal shale which on exposure shivers without becoming plastick; and coal, both the conchoidal and the brittle rhomboidal burning with flame. The argillaceous sandstone is very generally worked for building and mending the roads; a great number of the subsequent observations were made in these quarries, particularly in a very extensive one in the township of Pudsey which has been worked for above half a century, and furnishes many thousand tons of building stone, paving stone, and sandstone slate, annually. The bed of stone is of considerable thickness, probably above 40 feet. The upper stratum is a soft scaly sandstone which crumbles to fine sand on exposure to the air, and is frequently tinged yellow in various gradations by an impregnation of iron, it contains numerous indistinct impressions of vegetables in coaly matter, and has nodules which become apparent on the decay of the softer substances, consisting of a sandstone strongly impregnated with calcareous matter, so that the fracture in some directions appears sparry, and the mass effervesces with acids. I never saw traces of fossils in these nodules, which are a foot and upwards in diameter.

Beneath this stratum lies what is called by the workmen the rag, a grey sandstone possessing the properties of a freestone in cleaving, but of no great value on account of its softness, the numerous clayey blotches and black coaly spots which occur in it, and want of durability when exposed to the atmospheric influence. It contains numerous, and at times, very perfect fossil remains, also round bubbles sometimes empty, sometimes filled with ferrugineous sand. Under this the layers of wall stone, here called stone (which separates into laminae of two and a half or three inches and upwards, but not readily into thinner) the paving stone or flags, and the slate, differing in being more or less perfectly stratified, succeed. Mica is very abundant in small particles, particularly on the surfaces of the laminae. The stone is not got by blasting, but by clearing away the upper surface of a bed, and then applying wedges, and by taking advantage of the cracks which part the strata vertically into huge masses called *posts* by the workmen. In these parts of the stratum, fossils are seldom if ever found, it seeming as if the process of nature, which occasioned the laminated texture and rendered the mass so much more homogeneous and hard than the upper beds, entirely destroyed every trace of organised matter. It sometimes, but rarely happens, that the sides of the posts are united by calcareous spar,

also found it on the top of Ingleborough, in the coal strata of Northumberland; abundantly in Derbyshire; at Dudley, in

and in one quarry the fissures were filled up by a fibrous deposition resembling sattin spar which had evidently exuded from the opposite sides, crystalised in spiculæ, and by accumulating, at last filled up the cavity.

In these beds of stone, the state of the siliceous and argillaceous matter, of which they principally consist is singularly different from what obtains in the grits and some of the fine sandstone. In the grit it is well known that the quartz appears in various sized rounded pebbles, cemented together by what is generally esteemed an argillaceous cement; in some of the fine sandstones it seems to be in the crystallised form, and to cohere by mere approximation of the particles. The grit wears down to round sand and gravel, and the sandstone mentioned to sharp sand. But the argillaceous sandstone of the coal strata, turns to a dust in which we believe it is impossible to distinguish the argil and silica. Is it not therefore probable that they exist in these beds in a state of chemical combination, and not mechanical mixture, as seems to have been hitherto supposed, and that the apparent sandy texture is owing to the crystalline formation of the particles? If this be admissible, the cement of the grindstones will also probably be found to consist of this micargillite substance, for which at all events, we stand in need of a distinct name, sandstone being highly improper, as it neither looks like sand, nor can be reduced to sand by any known process. Siliceous clay seems more suited to its nature, but we venture on no innovations.

The principal quarries of this species of stone, and which have furnished us with specimens are, besides Pudsey quarries, those at Stanningly producing a fine grained real sandstone; at Bramley, near Farnley, and several other places.

The iron stone in these strata, consists in general of a combination of argil and the oxyd of iron, in various proportions. It is generally found in nodules imbedded in shale, differing in size, form, colour and attendant fossils. The colour indeed changes very obviously on exposure to the oxygen of the air. Besides the fossils mentioned below, these nodules produce a considerable number of filicites, and some verticillate fossils, and two or three species of fossil Mytili and Myæ.

Within the cavities of these shells, sulphuret of zinc, and crystals of quarz tolerably regular and transparent are occasionally found. The ironstone has been dug, particularly on Wibsey Low, and Upper Moor, and north westward towards Bradford, in which places there is a great succession of beds.

Sometimes, particularly in the neighbourhood of coal seams, the iron is combined with sulphur in the form of pyrites, (the *brasses* of the colliers) which occasionally forms the substance of organic remains.

Among the number of coal shales there is one which distinguishes itself by many peculiarities, and particularly by the fossils which it contains, on which account we shall endeavour to describe it, though it has not furnished any vegetable reliquia as far as we have been able to discover. The

Shropshire, and in the neighbourhood of Bristol. With respect to mineralogical constituent matter, it seems always to coincide with that of the stratum in which it is imbedded, with a slight modification of density. It is most abundant in the fine grained siliceous stone, provincially called *Calliard* and *Gannister*, and in some of the coal *Binds*, or *Crowstones*, which have probably received this appellation from spots of bitumen or coal attached to these petrifactions. It is rather less frequent in the beds of scaly clay, or clay mixed with siliceous sand and mica; very common but completely compressed in the coal shales or bituminous slate clay; of occasional occurrence in the argillaceous iron stone; not rare in the common grit, and upper thick beds of argillaceo-micaceous sandstone or *rag*, and sometimes, though rarely, discoverable in the coal itself. Mr. White Watson, of Bakewell, had also in his collection which we examined, a specimen in the Derbyshire Toadstone or Trap, and we have also noticed it in the limestone behind the Bristol hot wells, at its junction with the sandstone. So immense, however, is the number of relics, that when the eye has been accustomed to catch their appearance, it is scarcely possible to walk a furlong in the districts where they are at home, without meeting them in one shape or ano-

places where it has been met with in seeking coal are about two miles north of Halifax on the Bradford road, and I believe to a considerable distance to the east of this spot; at Idle, north of Bradford, and thence in an easterly direction to Coalhill near Stanningly, on the river Air. When first dug it is very similar to the common black coalshale, but on being exposed to the air, swells, the laminae being forced asunder by small crystals of selenite, which seem to be formed during the process of decomposition, by an union of the sulphuric acid and the calcareous earth with which it abounds. At Idle the bed contains a thin layer of long narrow crystals of selenite, which have an elegant appearance on the black ground. This bed of shale contains besides, nodules resembling those of ironstone, of hard black limestone, sufficiently abundant in some places to be used for lime, but generally attended by pyrites, and instead of the usual fresh water shells, we here meet with the Anomia Pecten, the Nautilus Listeri, an Orthoceratite, and probably some other marine productions in considerable abundance, indeed so much so, that the shale is sometimes quite covered with their impressions. The importance of the fact of a marine stratum interposed amidst a succession which is only attributable to fresh water, must immediately strike the geologist.

ther. The most perfect form in which this fossil occurs, is that of a cylinder more or less compressed, and generally flatter on one side than the other, (Plate IV. fig. 1 and 2.) Not unfrequently the flattened side turns in so as to form a groove. The surface is marked in quincuncial order with pustules, or rather depressed areolæ, with a rising in the middle, in the centre of which rising, a minute speck is often observable.* From different modes and degrees of compression, and probably from different states of the original vegetable, these areolæ assume very different appearances, sometimes running into indistinct rimae, like the bark of an aged willow, sometimes as in the shale impressions, exhibiting little more than a neat sketch of the concentric circles. (Fig. 4, 5, 6.) Mr. Martin suspected that these pustules were the marks of the attachment of the peduncules of leaves, and Tab. XII.* represents a specimen in which he thought that he had discovered the reliquia of the leaves themselves. We have examined the specimen whence the drawing, which is extremely correct, was made, but are convinced that Mr. Martin was misled by an accidental compression, in describing these leaves as being flat. Numerous specimens in gannister, in which the lateral compression of the trunk is generally trifling, place the assertion beyond a doubt, that the fibrous processes, acini, spines, or whatever else they may be called, are cylindrical, and small fragments of these cylinders shew distinctly a central line (pith?) coinciding with the point in the centre of the pustule. Convinced of the existence of these fibres, we were soon able to detect their remains, forming considerable masses of stone, particularly of coal Bind on Wibsey Slack, and at Lower Wyke, where their contorted figure imitates the figures of Serpulæ, but it excited much surprise on examining the projecting ends of some trunks which lay horizontally in a bed of clay, extending along the southern bank of the rivulet which separates the townships

* Mr. Martin terms these spots verrucæ, but whether they will strictly admit of the appellation seems doubtful.

of Pudsey and Tong, and which is exposed by slips in several places, to find traces of these fibres proceeding from the central cylinder, in rays through the stratum in every direction to the distance of above twenty feet. Repeated observations, and the concurrent conviction of unprejudiced persons made attentive to the phenomenon, compelled the belief that they originally belonged to the trunks in question, and consequently that the vegetable grew in its present horizontal position, at a time that the stratum was in a state capable of supporting its vegetation, and shot out its fibres in every direction through the then yielding mud. For if it grew erect, even admitting the fibres to have been as rigid as the firmest spines with which we are acquainted, it would be difficult to devise means gentle enough to bring it into a recumbent posture without deranging their position. This supposition gains strength from the circumstance that they are found lying in all directions across one another, and not directed towards any particular point of the compass.

The flattened and sometimes grooved form of one side of the cylinder has already been noticed. Woodward already observed, that along this side there generally, or at least frequently, ran an included cylinder, which at one extremity of the specimen would approach the outside so as almost to leave the trunk, while at the other it seemed nearly central. A reference to his Catalogue, Vol. I. part 2, p. 104, to Mr. Parkinson's Organic Remains, Vol. I. p. 427, and to Martin's Petrificata Derbiensia, l. c. will show how much this included cylinder has embarrassed those who have considered it with a view to the vegetable organ to which it owes its origin. In the specimens in Calliard which have suffered little compression, but which are seldom above a few inches in length, this body is generally nearly central; perhaps in no instance perfectly lateral. In the specimens in clay, from one of which we were able to detach upwards of six feet, the flattened or grooved side is invariably downward, and consequently the included cylinder in the position which it would assume if it had subsided at one end, while the other was supported, or which

would be the result of its sinking through a medium of nearly the same specific gravity with itself, provided it was at one end rather denser than at the other. It must be observed, that this included body appears to have suffered various degrees of compression, being sometimes cylindrical, which was evidently its original form, and sometimes almost entirely flattened; in the coal shale we were never able to detect a trace of its existence.

Besides these indications of organisation, we have met with several specimens which, on being longitudinally split, discovered marks of perforations or fibres, more or less parallel with the axis of the cylinder, and in some degree resembling the perforations of Terebellae in the fossil wood of Highgate and some other places. Whether these configurations be owing to the organisation of the original vegetable, or to some process which it underwent during its decay, seems impossible to determine; the specimens examined afforded no opportunity of discovering a connexion between these tubes and either the internal cylinders, or the external surface.

Among the vast number of specimens examined, only one was detected, which appeared to terminate, closing from a thickness of three inches to an obtuse point. We have given a figure of it, Plate IV. fig. 3. Two instances also came to our knowledge, of branched specimens, in which the trunk divided into two nearly equal branches. So rare an occurrence of this circumstance would however, rather induce the supposition that the original was properly simple, and that these were only exceptions or monstrosities. The size of different specimens varies greatly, but we have seen none under two inches in diameter; the general size is three or four, and some occur, but with very indistinct traces of the pustules, even 12 inches across.

From the above it appears rational to suppose, that the original was a cylindrical trunk or root growing in a direction nearly horizontal, in the soft mud at the bottom of fresh water lakes or seas, without branches, but sending out fibres from all sides. That it was furnished in the centre with a pith of

a structure different from the surrounding wood or cellular substance, more dense and distinct at the older end of the plant, and more similar to the external substance towards the termination which continued to shoot. And perhaps, that besides this central pith, there were longitudinal fibres proceeding through the plant like those in the roots of Pteris aquilina. With respect to any stem arising from it, if a root, or foliage belonging to it, if a creeping trunk, we have hardly ground for a supposition.

If these points be assumed as ascertained, the manner in which the reliquia were formed is easily accounted for. Annual decay, or an accumulation of incumbent mud having deprived the trunk of the vegetating principle, the clay would be condensed by superior pressure around the dead plant so as to form a species of matrix; if this took place so rapidly that the mould had obtained a considerable degree of consistency before the texture of the vegetable was destroyed by putrefaction, the reliquium was cylindrical; if, on the contrary, the new formed stratum continued to subside, while the decomposition was going on, it became flattened, and the inferior part might even be raised up towards the yielding substance in the inside, so as to produce the groove or creest, as Woodward calls it, on the under side, in the same manner as the floor in coal works is apt to rise where the measures are soft, and the roof and sides have been secured. While the principal mass of the plant was reduced to a soft state, and gradually carried away or assimilated with mineral infiltrated matter, the central pith being unsupported, would sink towards the under side, and this the more sensibly where its texture was most distinct, while its anterior extremity would probably go into putrefaction with, and be lost in the more tender part of the plant. The mineral matter introduced would now form an envelope round the pith, where this resisted decomposition for a sufficient length of time, and when it was ultimately removed, if the surrounding mass was still sufficiently pervious, be also filled with argillaceous matter, or, if it was too much indurated, be left empty, which is

the case occasionally. The epidermis or external integument of the vegetable, appears to have resisted decomposition the longest, as in many cases it has been preserved from putrefaction in the manner necessary to change it into coal; its place more frequently, however, is occupied by a ferrugineous micaceous film. It therefore appears, that the original plants must have undergone a destruction by putrefaction, and the vacuities thus occasioned been very rapidly filled with mineral matter. This is evident from the reliquium in its present state exhibiting no minute traces of organisation, nor any signs of bitumenized vegetable matter so frequent in siliceous and opaline wood, except in the epidermis, and from the close similarity which this substance bears with that of the surrounding stratum; whereas in shells, &c. which have evidently undergone a very gradual lapidifying process, there is generally a very perceptible difference between the matter substituted and the surrounding mass.

Several conclusions interesting to the science of geology, will readily be drawn. The formation of these strata from the deposit of water is clearly ascertained, also that the argillaceous strata in question must have been when originally deposited of nearly the same thickness as they now are, as appears from the undisturbed position of the vegetables of which they were once the bed, and are now the tomb. On the other hand, the shale of coal or slate clay appears to have originated from a great number of successive depositions, which must have been of a very diluted consistence, when vegetation became extinct in the plants of which they now bear the impressions. All these strata must be supposed to have been successively at no great depth from the surface of the water resting upon them, that these plants might be supplied with air; and the situation in which they are found precludes the possibility of any motion of that sea sufficiently violent to disturb the bottom. The general diffusion of this and several of the following species, strongly suggests the belief that all the coal strata through which they are dispersed, owe their existence to a similar origin.

Sp. II. PHYLOLITHUS *sulcatus*, Plate V. Fig. 1 & 2.

Martin Petrif: Derb. Plates 8. 25. 26.—*Parkinson, Organic Remains, Vol. I. Plate III. Fig.* 3.—*Luid, Lithophyllacion Brit. Tab. V. Fig.* 184. 6.—*Scheuchzer, Herb. Diluv. Tab. IV. Fig.* 1.—*Volkammer, Siles. subterr. Tab. VII. Fig.* 7. *Tab. VIII. Fig.* 6.

Mr. Martin has described and figured this species under the names of Phytolithus sulciculmis and striaticulmis. The characters distinguishing these two varieties appear too vague, and too many intermediate gradations exist, to permit us to constitute two distinct species, and we are induced to depart from his names, as it is by no means ascertained that the original was, strictly speaking, a culmus. Mr. Parkinson, Mr. Luid and Scheuchzer's specimens were very imperfect. Its geographical habitat corresponds with that of the former species, but its geological situation appears rather to vary. We have found it in sandstone (argillaceous, the thick laminated upper bed of the quarry, called *rag*) and in ironstone abundantly, also not unfrequently in the coal shale, but have never been able to detect it in the coal, nor in the argillaceous beds which produce the former species so abundantly. Indeed, if it had existed in the latter, it is hardly possible that it could have escaped our notice; it seems also to be wholly absent from the Calliard. It must certainly be ranked among the fossils of more frequent occurrence, but as with the whole class, so with this species, fragments and traces are far more abundant than perfect specimens. On account of the peculiarity of its structure, very minute portions are recognised among the numerous specks of coaly impressions abounding in the rag, the greater part of which can be referred to no

particular species, but it is more usual to find tolerably perfect specimens in iron stone.

The most perfect form in which we have met with it, is that of a gently tapering cone, ending in a somewhat obtuse point, divided into joints, and longitudinally striated, each stria having at the joint a protuberance indicating a fibre or leaf in the original. In a single specimen in standstone, represented in Plate V. fig. 2, traces of the whorls of leaves or fibres were very distinct, but only towards the termination of the plant. Da Costa mentions a specimen with a large bulbous root, but we have never been fortunate enough to meet with any thing to which that name was applicable.

The size, joints and striæ of this vegetable, to judge by its reliquia, must have been liable to the greatest variety, if we do not suppose that under a single name we in fact comprise a whole family of plants. The cylindrical or nearly cylindrical part of the trunk varies from one quarter of an inch in diameter to six or more inches, besides the accidental varieties from compression; the joints are sometimes at the distance of less than half a diameter, at others two or three diameters asunder; sometimes, they grow gradually closer and closer towards the end, at others a short joint is placed between two long ones. Some specimens are finely striated, others widely ribbed, and a few occur in which the projecting part between each sulcus has a finer line impressed along its course, so as to divide it in two. We have not met with more than about a dozen terminations, almost every one of which differs considerably from the other, but three in iron stone had the remarkable coincidence of being curved as if the original had withered, and the end been bent down by the weight of the leaves attached to it. If this was the case, we must suppose the prototype to have been of a very succulent nature. We have no grounds to imagine, that we ever detected this plant in the situation in which it originally grew, as was the case with the former, nor have we been able to discover any traces of internal organisation.

The original seems to have vegetated in an upright position, with a reeded, jointed trunk, surrounded at every joint towards the top with a whorl of leaves; from the manner in which its fragments are found, it appears either to have been hollow or to have had a brittle and probably elastic outer coat, which in many instances is converted into coal. The traces of the insertion of the peduncules of the leaves into the joints, is most visible in the ironstone specimens, (Plate V. fig. 1.) though we never could find any marks of the leaves themselves in that matrix. Frequently single joints are found, and called by the ironstone diggers, *cork stones;* often, however, several occur united, which break not across the joints, but in a sloping direction, owing to the texture of the stone. It is remarkable that cubic crystals of Galena (sulphuret of lead) are often discernible upon the ironstone in these reliquia, but never to our knowledge pyrites or sulphuret of zinc, which occasionally present themselves in the cavities of shells in the same strata.

We may safely assert that this species was not subaquatic, as, if this had been the case, we could hardly have failed to find it along with the former, whose reliquia are in so undisturbed a state.

Persons acquainted with the appearances of tropical vegetation have informed us, that some of the thicker specimens resemble the young shoots of the Surinam bamboo, when first appearing above ground.

Sp. III. PHYTOLITHUS *cancellatus.* Plate VI. Fig. 2, 3, 4, 5, 6.

Martin, Petrif. Derb. Plates 13. 50.—*Sowerby, British Mineralogy, Plates* 39, 40, 385.—*Da Costa, in Phil. Trans.*—*Parkinson, Organic Remains, Vol. I. Plate I. Fig.* 6. *Plate II. Fig.* 4.—*Volkmann, Silesia Subterr. Tab. VIII. Fig.* 10, 11, 12, 13.

This remarkable fossil appears to have been very generally confounded with others, some of which will be mentioned below, and which resemble it in exhibiting a cancellated appearance.

Mr. Parkinson united with it a fossil of a very distinct nature, Org. Rem. Vol. I. Plate lX, fig. 1. and Mr. Martin, though he points out Mr. P.'s error, is himself led into a mistake when he identifies it with the impression, Tab. 14.

The fact is, that there are not less than six (probably more) fossils of vegetable origin, occasionally occurring in the coal strata, all which, under certain circumstances, present a reticulated surface, and seem on this account to have been designated *squamata schemata*, by Dr. Richardson, (Luid. p. 111.) Blumenbach in his Handbuch, terms them paradoxical fossils, and notices their having been found in the Grisons, and in Scotland. All of them are found in the argillaceous ironstone, and some in the coal shale, but the species in question appears very frequently in the argillaceous sandstone, and occasionally in the coal.* The imperfect state of the various specimens render it almost impossible to give a description from anv one, such as shew the habitus of the plant, being generally deficient in the marking; and such as have the marks in the highest perfection, generally displaying only a part of the cylinder. From the former we learn, that the original had a cylindrical trunk dividing not unfrequently into branches,

* A specimen of this kind evidently gave rise to the story (afterwards retracted) of a fish found in coal. Parkinson, Vol. III. p. 250.

but not strictly dichotomising; was probably furnished with a cylindrical pith or central body which resisted putrefaction longer than the surrounding substance, and had its surface divided into rhomboidal projections the interstices between which form a kind of net work or lattice work, the longer diameter of the rhombs being parallel with the axis of the cylinder. From the fragments which exhibit the markings of these rhombs in the most distinct manner, we become acquainted with three distinct species of configuration, apparently arising from the epidermis, the inner bark, and the wood of the prototype; and which for convenience (though the supposition is still open to more close enquiry) we shall distinguish by the names of *epidermal*, *cortical* and *ligneous*.* In the *epidermal* appearance the rhombs are divided by lines forming a net work, so that the rhombs are quite approximate; these lines are not right lines, but waved in a manner which, as Mr. Parkinson observes, is extremely difficult to express by drawing, and which eludes description. From an examination of very perfect specimens belonging to this class, the marks upon the separate rhombs are found to be the following: the upper angle, for about one third of the vertical diameter, is elevated and rather rough with a depression in the centre. The lower side of this elevated triangle runs out in the middle in a ridge towards the lower corner of the rhomb; in the sinus formed by this ridge, and the lower ridge of the triangular elevation, there appears on each side an oval cicatrix, Plate VI. fig. 3.

Or thus: From the lower corner of the rhomb, a ridge runs in the direction of the longer diameter. When it has got somewhat beyond the centre, it divides into two arcs which go off towards the upper side of the rhomb. The space included between these arcs and the upper corner is elevated and rough, and has in the middle a depression, and in the sinus of the

* We presume that ligneous may signify *belonging to wood*, as well as *anade of wood*.

arches, where they leave the central ridge there is on each side an oval cicatrix. The configuration resembles that on the scales of the cones of some species of pine pretty closely at first sight, but seems much more analogous to those on some of the Cacti, as the cones of pines have neither the depression nor the cicatrices which in the Cacti might be occasioned by the aculei with which they are armed.

In the *cortical* appearance the lines between the rhombs are of some breadth, the ridge appears broader and less defined, and forms with the contracted superior elevation only one protuberance, in which the two cicatrices are perhaps never visible, and the central depression assumes the figure of a squamula. Mr. Martin's Plate XIV. seems to have been taken from a specimen of this kind; but it must be remarked that neither this nor the preceding class of appearances are often as distinct as described, the former being generally completely flattened so as to lose its relief, though it still retains traces of the various figures, and the latter degenerating into a mere central protuberance. Plate VI. fig. 4 and 5, represent the matrix and cast of part of a fine specimen of the cortical impression in sandstone. The ligneous appearance differs extremely from the two former, and only close observation enables us positively to assert that it originates from the same plant. The cancellated appearance is here entirely lost, the surface is slightly striated with a scarcely perceptible rising under the central ridge, and a minute but distinct raised dot in the place of the depression in the epidermis. It has all the appearance of the peeled stem of a plant which had been furnished with small branches or spines in quincuncial order. Plate VI. fig. 6. is part of a large specimen in ironstone, which was thickly enveloped with bituminous matter, the outer coat of which, and the matrix, exhibited the epidermal appearance.

From these three appearances, variously modified, the different aspects of this protean fossil may be explained. It frequently happens, that the cast and impression are from different integuments, the space separating them being occu-

pied by carbonised or bitumenised vegetable matter. Thus in the most perfect specimen of the ligneous appearance which we have met with, and from which our figure is sketched, the impression was the epidermal; at other times the impression is epidermal and the cast cortical, and again not unfrequently both cast and impression epidermal, cortical or ligneous. The manner of accounting for these varieties is obvious, it only requires us to suppose the cast and the impression, or matrix, to have been formed, while part of these integuments were still in their natural state, which being thus inclosed was, afterwards, changed into bitumen or coal.

The appearance of some specimens seems strongly to suggest the idea that the bark was furnished or composed of strong longitudinal fibres, and almost all betray a tendency to be striated in a vertical direction.

The few specimens which exhibit traces of a pith, inform us that it also was very finely striated in a longitudinal direction, but afford no further information respecting the internal organisation of the original.

With respect to the singular, extremely beautiful, and regular markings of this fossil, their cause, use and nature appear to have been hitherto but little elucidated; from repeated and numerous observations we were led to believe that they could be no other than the cicatrices left by the fall of leaves or stipulæ, somewhat resembling those which may be observed on the stalk of the cultivated variety of the cabbage, or on pulling off the footstalks of the leaves of the Nymphæa from the root; with the difference that in the fossil these cicatrices are arranged close together, and that they are elongated in a direction parallel to the trunk. If this be supposed, the depression in the epidermal appearance, corresponding with the minute protuberance in the ligneous, probably indicated the woody fibre running along the midrib of the leaf from the wood of the trunk; the rough projection would be the part to which the vessels forming the upper plate of the leaf would be attached, the cicatrices on either side of the central ridge would mark the progress of air or sap vessels

to the under plate of the leaf from the bark; and the spaces around or beside them, the attachment of two bundles of parenchyma abutting against the lower part of the petiole as is usually the case, and afterwards expanding so as to form the under surface of the leaf.

This solution still appears sufficiently natural, but a close examination of some of the genus Cactus, but particularly the Cerei, as hinted above, incline me to think that we shall ultimately find a pretty close analogue among them, in which a fibre or leaf will correspond with the upper depression, and a couple of aculei with the lower cicatrices. This will obviate the difficulty of supposing a plant so thickly beset with the petioles of leaves as to be totally covered by them; at the same time we must acknowledge that the manner in which our fossil sends off its branches, is wholly dissimilar to any of the Cacti we know.

The impressions of this vegetable in the different substances before mentioned, are often extremely beautiful, from the highly finished relief with which they are ornamented, those in shale are also of a neatness surpassing the most elegant productions of the graver, nor are those in the coarser matrix of argillaceous sandstone unsightly, being generally very perfectly marked by coal. The impressions in sandstone are generally much more perfect than the casts themselves, few of which exhibit the markings very distinctly.

The varieties of form and size in which these fossils occur, are very numerous. Those which exhibit the whole circumference of the cylinder* are generally about two and a half or three inches in diameter, and we have not seen a detached specimen above a foot or fifteen inches in length. Impressions considerably longer not unfrequently occur among the rubbish of stone quarries, but we could never obtain the entire

* The compressed cylindrical specimens of vegetable fossils are seldom (we believe *never*) equally distinct all round, one side being generally more or less obliterated, and not unfrequently lost in the matrix, which is easily explained, if the substance was in a horizontal position when the petrefactive process took place.

casts. The flattened impressions in the coal shale are often considerably larger, one found at Shelf, near Bradford, containing near three square feet of surface. The size of the markings or rhombs also differ greatly; in some specimens in ironstone, they are scarcely one quarter in length, in others above an inch, and in one indistinct specimen in sandstone, a rhomb might be traced above three inches long.

The uncertainty involving this fossil is greatly increased by the scarceness of good cylindrical specimens, and the great varieties of shape which the fragments assume, perfectly flattened, compressed or beset in almost every direction, so that it is difficult to conceive how they could possibly originate from a cylindrical trunk; to which may be added, that the markings of the rhombs are always much more perfect in these fragments.

It may also be deserving of notice that the quantity of coaly matter attending these remains is, generally speaking, much greater than in the two former species, and sometimes forms a hard durable coat, though more frequently it crumbles away on being rubbed.

This species does not occur in the clay beds with the Phytolithus verrucosus, nor have we discovered it in Calliard; the specimens above alluded to in coal were no more than a trace of the rhomboidal configurations in a white matter, resembling a drawing with white lead on the surface of the coal.

Sp. III. PHYTOLITHUS *parmatus*, Plate VI. Fig. 1. and Plate VII. Fig. 1.

Grew. Mus. Tab. VII. 274? (Scheuchzer, Herb. Diluv. p. 119.)

With the exception of Grew, whose name is introduced only on the authority of Scheuchzer, this fossil appears to have escaped the notice of all former writers on petrifactions to whose works we have ever had access. It is possible that parts of it may have been mistaken for fragments of the last species, but the more complete specimens (and the best we have been able to obtain are very far from being as complete as those of the former reliquia) possess characters so strikingly singular as to distinguish them immediately from the whole class. The specimens which we have obtained have all been from the iron works at Low Moor and Shelf, both near Bradford; and the mass either the argillaceous ironstone, or the coal shale. We never have detected a trace in any other stratum, which probably would have been the case had it existed in them, though it certainly must have been a vegetable of much rarer occurrence, or much less capable of the petrefactive process than either of the former.

The specimens we have seen do not authorise us to assert that it is ever found in a cylindrical form, as they all present only an extended surface. However, such specimens of the former species are by far the most common, and yet its more perfect shape is undoubtedly cylindrical, this circumstance by no means implies that the reliquium in question may not have owed its origin to a vegetable that was also cylindrical.

The surface of this fossil presents an appearance in some degree resembling the last species, being also reticulated; but even these reticulations, on close examination, are wholly different; they are formed by projecting decussated lines, which thus include rhomboidal spaces, bearing none of the

marks so interesting in the Phyt. cancellatus; but simple depressions. They also differ very perceptibly in being less than is generally the case in middle sized specimens of the latter.

But the most remarkable and inexplicable part of the organisation of this fossil consists in a series of circular or oval scutellæ or shields, placed close to each other in a right line across the surface. The various specimens hitherto met with having been merely fragments, and the difficulty of finding any thing analagous to these scutellæ in the vegetables of the present creation, render it unwarrantable to apply any appellation to them as gemmæ, buds, flowers, &c. which might lead to the conclusion, that their origin was ascertained; we are hitherto quite in the dark with respect to their nature, and could only offer the vaguest suppositions, notwithstanding considerable diligence was bestowed in the search after circumstances which might throw light upon them. It therefore only remains to describe them such as they appear, and to endeavour to reconcile their various appearances by the simplest conjectures we can form.

Three distinct kinds of appearances of this fossil have come under our notice, two of which from a degree of resemblance with appearances of the last species we may call the epidermal and ligneous. The third is widely different from any thing we have met with among these fossils, but easily accounted for by supposing projecting spines or fibres cut transversely at a distance from the vegetable, and leaving traces of their section on a plate of shale.

The *epidermal* appearance is that usually met with, in which the parmæ are surrounded by a raised margin; the included disk swells towards the central umbo or boss in curiously disposed rugæ, and the boss is generally more or less excavated in the centre. These configurations on the surface of the shields vary in almost every specimen, yet so that it is not difficult to trace their analogy, and the identity of the different marks. The raised margin is constant, and there is always a tendency of the other lines and protuberances towards the centre, not in the direction of the radii, but in a manner slight-

ly resembling the figures on the back of an engine-turned watch-case, produced by describing several circles, whose centres are situate in the circumference of another circle round the middle of the plate. But the protuberances sometimes appear only as lines of projecting points, at others like continued ridges, and again as ridges indented into a series of projections, which are so placed as to give part of the disc a reticulated appearance; a precise idea, however, of the arrangement of these marks can hardly be formed but from an attentive examination of the specimens themselves, or their representations, when it will be found that notwithstanding their variety they are regulated by that law of order so universal in organised nature, which, while admitting infinite modifications, retains inviolate the characteristic principle. Plate VII. fig. 1. represents the largest and one of the most perfect specimens that we have met with. The specimen is in argillaceous iron ore from Shelf.

The series of parmæ is generally bounded on each side by a rather indistinct ridge, beyond which the surface has the recticulated appearance at first described.

The general shape of the parmæ does not much vary, except becoming oval from lateral compression, but the size is not constant, and it is remarkable, that while those in ironstone exceed two inches in diameter, those in the shale seldom arrive at one. Perhaps the consistence of the original was different at different stages of its growth, and consequently better suited for preservation in one medium at one time, and in another at a different.

To determine the number of parmæ which form a series, or how the series ends, is out of our power; we have observed six or seven in some specimens, but they were apparently equal in size, and there was no reason visible why the row should be nearer its termination at one end than another. The total appearance of the fossil has a curious resemblance to that of some of the Jungermaniæ preparing for fructification when highly magnified.

Of the *ligneous* appearance we have hitherto met with a single instance, but it is a comparatively perfect specimen, and very well defined, so that notwithstanding the wide difference of aspect, we do not hesitate to refer it to the same original. Plate VI. fig. 1. exhibits a representation of the concave part or matrix of this specimen.

The reticulated appearance is here wholly wanting; the surface has an appearance more resembling the bark of the beech, apparently indicating an organisation, the fibres of which are at right angles to the series of parmae. The rugae of the parmae are almost wholly obliterated, but the umbo is more decidedly and neatly marked. It forms a distinct flattened conical protuberance slightly furrowed and excavated at the apex. The margin continues distinct and raised. But the most singular circumstance attending this appearance of the fossil is, that no traces of organisation are visible which do not seem to be continued in the epidermal covering. Parallel with the series of parmae, and at no great distance from it, there is a narrow groove alternately shallower and deeper, from which at distinct intervals there appear to have issued minute fibres, if the cicatrices left will warrant the supposition. It must also be remarked, that this groove is to be traced only on one side of the fossil, but that it is again repeated at some distance.

The specimen in question is in ironstone, but of the size of those usually found in shale, and the surface is not flat, but curved in a direction perpendicular to the row of parmae. The *third appearance* alluded to above, consists merely of an elegant arrangement of minute points, issuing in curved lines from a centre, which we have once or twice met with in shale. The manner in which they are placed, seems sufficiently to indicate that it belongs to this species, and we should be apt to infer from this mode of appearance that in the original, fibres rose perpendicularly to the surface of what has furnished our fossils, from the protuberances on the parmae, transverse sections of which gave rise to the impressions in question.

The idea has suggested itself that the configurations on the parmae bear some resemblance to the arrangement of the fibres in the leaves of plants while still twisted together in the bud, as they appear on a transverse section, but the central umbo forbids our supposing them to have originated from mere buds, a circumstance indeed which their very position renders improbable. The fact seems to be, that we have no sufficient data to form any competent idea of the prototype.

The quantity of coaly matter accompanying this petrefaction, seems fully equal to that in the former species.

The above four species form by far the greater part of the fossil reliquia belonging to indeterminate vegetables occurring in the coal strata, which we have had an opportunity of examining. We have formed the description of them, not from solitary detached specimens, but, unless where the contrary is mentioned, from the observation of numbers, and can therefore lay them down with some degree of confidence. In the course of our enquiries it may be naturally supposed that various other specimens of different fossils fell into our hands, some of these possessed characters distinguishing them decidedly as particular species, but want of number prevents our tracing the boundaries within which their varieties may range; of the more remarkable of these we shall add a catalogue with such observations as we are enabled to make. Other fragments seemed apparently different from any of these species, but from our limited acquaintance with the varieties of the latter, or their imperfect state, would not warrant any decisive conclusion; and again, some of the species described by Da Costa, Mr. Parkinson and others have hitherto eluded our research, or are wholly wanting in the strata we had an opportunity of examining. Confident that it has not been the result of unwillingness to learn, we shall as little hesitate to

acknowledge our ignorance as to communicate our experience.

Sp. V. PHYTOLITHUS *reticulatus.*

This species may perhaps ultimately prove to be the same with that last described, either in a different state, or from a different part of the plant. It is not altogether uncommon in the ironstone, and probably gives rise to some of the cancellated configurations on the coal shale. Its appearance is much like the reticulated part of the Ph. parmatus, but from our being uncertain which is matrix and which cast in the specimens we have obtained, we are at a loss whether to describe it as divided into rhomboidal cavities by projecting lines or as studded with protuberances, the interstices of which form a netted appearance. The former seems more probable from the circumstance that in what we esteem the most perfect species of this fossil the projecting lines seem in some degree to proceed from a ridge or midrib running across the surface.

Some specimens which we have seen are singularly bent, as if the articulations of the closed fist had been pressed into the substance, while soft.

All that we have hitherto met with have been in the black argillaceous ironstone, and had a coating of bituminous matter of considerable thickness and tenacity.

They were from Low Moor and Shelf.

Sp. VI. PHYTOLITHUS *Martini.*

On plate 14, of Mr. Martin's Petrif. Derb. fig. 2. there is a fragment of a rather large reticulated impression in an ironstone nodule; this we suspect, though not without much doubt and hesitation, to belong to a curious fossil, coinciding with

the three former species in the cancellated surface, and which may perhaps be a variety or young specimen of Phyt. cancellatus; should it prove to be distinct, which we are inclined to think it is, we wish to distinguish it by the name of that diligent and accurate naturalist.

We have never, as far as we know and can recollect, been able to meet with the cast, though we have found several specimens of the matrix of this fossil in the brown argillaceous ironstone. The most perfect of these, shews distinctly that the original resembled the branch of a tree about an inch in diameter, nearly cylindrical and nearly straight, dividing into two in a mode apparently resembling the smaller branches of the Pinus picea. The surface appears to have been deeply and very distinctly cancellated, but as far as we can discover, without the central depression and cicatrices of Phytolithus cancellatus. The rhombs are also different in shape, the longer diameter being transverse, instead of parallel, with the axis of the cylinder. We cannot positively ascertain whether this matrix was left hollow, or whether (which is more probable) the substance of the vegetable was substituted by pyrites, which had fallen out before it came into our hands, but it shews the form of the original very completely, the whole circumference of the cylinders of both branches being complete for some length.*

* This species seems to bear a superficial resemblance to that which Mr. Parkinson describes and figures. Org. Rem. Vol. I. p. 427, and Pl. IX. fig. 1. and which led him into error with respect to the origin of the Phytolithus cancellatus. We have frequently met with his fossil in nodules of ironstone, the place of the original vegetable being generally substituted by pyrites; impressions of it, or what we take to be such, also occur in the coal shale, but to an attentive observer, in possession of good specimens, there is little danger of confounding it with any of our species. The surface of Mr. Parkinson's fossil is evidently scaly, analogous to the cone of Pinus abies, the matrix generally insinuating itself beneath the projecting scales, so that parts are inevitably broken off in detaching the pyrites, which produces indeed a reticulated appearance, but by no means as perfect as in our species; in Phyt. Martini, the termination has not yet been met with, but it is probably very different from that of Mr. Parkinson, and it is hardly likely that its cast would present the radiated fibrous arrangements, visible

Sp. VII. PHYTOLITHUS *transversus*. Plate V. Fig. 3.

This very simple but perfectly distinct fossil seems hitherto to have escaped the notice of naturalists. We have obtained tolerably perfect specimens in sandstone, and have traced it in the ironstone. It appears to be a simple cylindrical trunk transversely closely striated, without any traces of leaves or fibres. All the specimens which we have found were considerably compressed, the longest about six inches long, and not quite a half inch broad, (in its flattened state) the broadest less than an inch in diameter. They were all equally thick at both ends, nor was there any indication whereby a guess could be formed, which was the upper and which the lower extremity, or whether it belonged to a horizontal creeping root. The general appearance was much like that of a very large earthworm. From the fineness of the striae or annuli, and these probably being only superficial, it is not unlikely that some of the indistinct cylindrical fossils, and other fragments discernible in the upper beds of argillaceous sandstone, may belong to this species.

Sp. VIII. PHYTOLITHUS *Dawsoni*, Plate I. Fig. 7.

From the kindness of Jos. Dawson, Esq. of Royd's Hall, near Bradford, one of the proprietors of the extensive iron works at Low Moor, I received a specimen exhibiting on one side a cast, and on the other an impression, in bitumen or coal, of a fossil which is evidently very distinct from any of the preceding.

in the latter. The latter is very decidedly the petrefaction of some part of fructification, if not the cone of a Pinus, which analogy prevents us supposing of the former on account of its being branched. We therefore think ourselves justified in omitting Mr. P.'s fossil in this catalogue, and including ours under the head of indeterminable species of vegetable fossils.

This fossil is longitudinally divided by pretty deep sulci into ribs of considerable breadth, which have been beset with fibres or leaves placed, so that the cicatrices or marks where the fibres left the wood in each rib alternate with those on the adjoining. It seems natural to suppose that the original was an upright cylindrical trunk, with foliage arranged in this manner, but the solitary specimen does not furnish us with means to determine how many series of leaves there were in the circumference, much less what their former texture may have been. The impression in coal has considerably larger ribs than the other, and lies on the under side of the thin plate forming the specimen in a different direction from the other. The substance appears to be the grey argillaceous coal shale.

In the possession of Mr. Salt, of Sheffield, was a fossil, allied to the former; it was a compressed cylinder, and very perfect on one side; the leaves were inserted in the manner above described, beneath each of the cicatrices was a slight protuberance, and the whole was faintly transversely striated. It was not divided into ribs by sulci like the preceding, though the marks of the petioles gave it a somewhat striped appearance.

Sp. IX. Phytolithus *notatus*. Plate VII. Fig. 3.

This species, which seems to be intermediate between Phytolithus Dawsoni, and Phytolithus tessellatus, we obtained from the coalpits of Dunkerton, Somersetshire. The mass is slate clay, invested on both sides with bitumenous matter, bearing longitudinal series of cicatrices, of a rounded pentagonal form, with a central mark; the series separated by very distinct sulci. Where the bituminous matter is removed, the slate clay itself exhibits a fibrous surface, no traces of the cicatrices, but under the central mark a projecting point. The latter appearance we suppose to be the ligneous, and

that on the bitumen the epidermal impression. Parkinson, Org. Rem. Vol. I. Plate V. fig. 8, represents a somewhat similar fossil. The original of Phytolithus notatus must have been of considerable size, our specimen being seventeen inches long, and above nine broad, though imperfect on one edge; and the cicatrices do not sensibly vary in magnitude.

Sp. X. PHYTOLITHUS *tessellatus*, Plate VII. Fig. 2.

The solitary specimen here represented is ironstone from Shelf. Like the two former it is marked by longitudinal sulci, dividing it into ribs, which are again crossed by transverse separations, giving it a tessellated appearance.

Besides these species which may be looked upon as ascertained, though from a comparatively small number of specimens there are some which still involve considerable doubt. We shall only notice two. Of the first only a single decided specimen came to our view; its form was cylindrical, slightly bent, the surface in a very faint degree striated, but the whole surrounded by an unusual quantity of coaly matter. It is remarkable that the fossil itself was scarcely at all compressed, while the coal was very much so, presenting the appearance of a continued fin along either side. The specimen assists in elucidating a circumstance very frequently attending those petrefactions, in which part of the original vegetable matter is transformed into coal. In such fossils the cast is sometimes very neat and complete, as in the present instance, while the matrix on the contrary is very indistinct, at other times the cast is very obscure, while the matrix exhibits all the markings very neatly.* From these observations it would appear, that sometimes the cast set or hardened before the

* This is very generally the case with the impressions and casts of Phytolithus cancellatus, in the argillaceous sandstone rag, and often occasions grievous disappointments in collecting.

matrix, sometimes the matrix before the cast, and that one or the other continued soft, after the vegetable matter had undergone that degree of liquefaction which must evidently have taken place before it was converted into the coaly substance which we now find. When on the contrary the vegetable matter assisted decomposition till both the cast and the matrix had become fixed, both must exhibit equally perfect traces of the original form, which is sometimes the case. It seems also impossible from the above, to imagine the operation of fire to have had any share in effecting any of these changes.

The second indistinct class of fossils which obtains very generally and exclusively in the sandstone, consists of broad stripes of carbonaceous matter pervading the rock, and leaving on the surface of the stone an impression resembling a leaf. They may perhaps, be owing to the remains of some cylindrical trunk, but from this never being found perfect, (except the last mentioned specimen be of this nature) and from their great size, this is hardly probable. We have found them above four feet in length, and eight broad, and bent into various portions of cylinders, indeed in some quarries there is scarcely a stone of the rag which does not contain a fragment. If they be supposed to be leaves, they are certainly very different from those linear leaves, whose impressions are not uncommon in the coal shale.

Thus far we have in some measure succeeded in unravelling the intricacies occasioned by these mysterious relics of a former creation. But still the numberless stains in the sandstones, the blotches which appear in splitting them, and the perforations and cavities which occur among them, are sufficient proofs that we are acquainted with only a small part of the vegetable riches of that world. To patient investigation, and the concurrence of favourable circumstances, we leave their consideration, with a wish that the few hints put down may encourage others to take up the subject—and proceed.

REFERENCE TO THE PLATES.

Plate IV. fig. 1 and 2. Upper and under sides of *Phytolithus verrucosus.*
fig. 3. Termination of *Phyt. verrucosus.*
fig. 4, 5 and 6. Different appearances of the areolae on *Ph. verrucosus.*
fig. 7. *Phytolithus Dawsonii.*

Plate V. fig. 1. Termination of *Phytolithus sulcatus,* in ironstone.
fig. 2. Termination of *Ph. sulcatus* with part of the matrix exhibiting the whorls of leaves, in sandstone.
fig. 3. *Phytolithus transversus,* in sandstone.

Plate VI. fig. 1. Ligneous impression of *Phytolithus parmatus,* being the concave matrix in ironstone.
fig. 2. Fragment of *Phytolithus cancellatus,* the epidermal impression exhibited by the concave matrix in ironstone.
fig. 3. Single rhomb of a very perfect specimen of *Ph. cancellatus,* in ironstone.
fig. 4 and 5. Fragments of the cortical impression, both matrix and cast of *Phyt. cancellatus,* in sandstone.
fig. 6. Ligneous impression of *Ph. cancellatus,* in ironstone.

Plate VII. fig. 1. Epidermal impression of *Phytolithus parmatus* in ironstone.
fig. 2. *Phytolithus tessellatus,* in ironstone.
fig. 3. *Phytolithus notatus,* in slate clay.

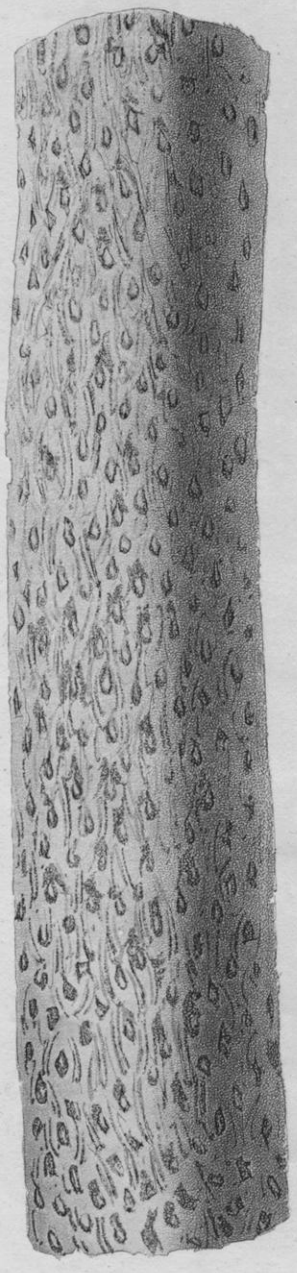


Fig. 1.

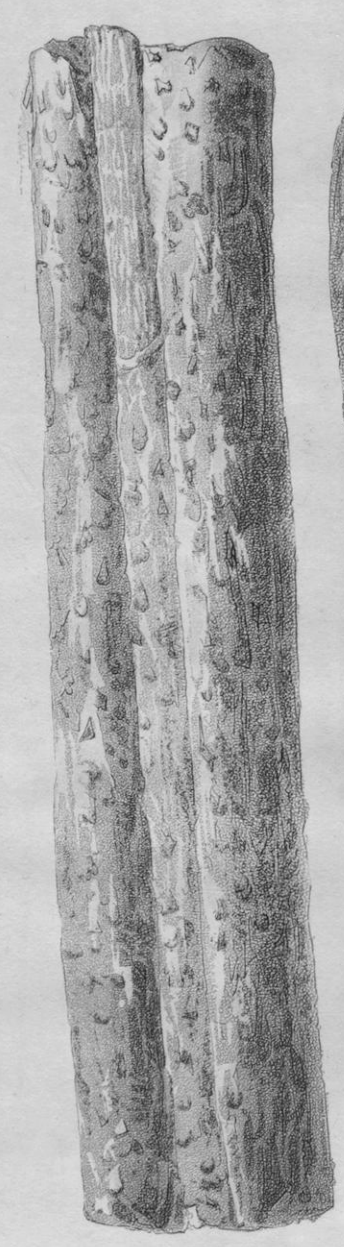


Fig. 2.

Fig. 3.

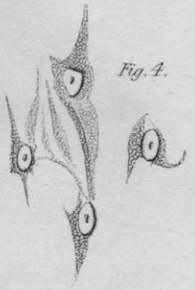


Fig. 4.

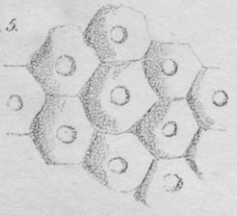


Fig. 5.

Fig. 6.

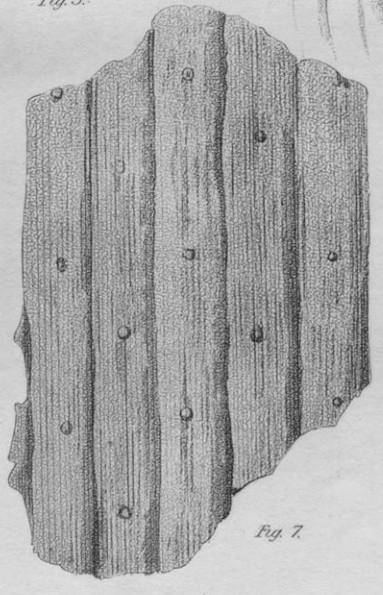
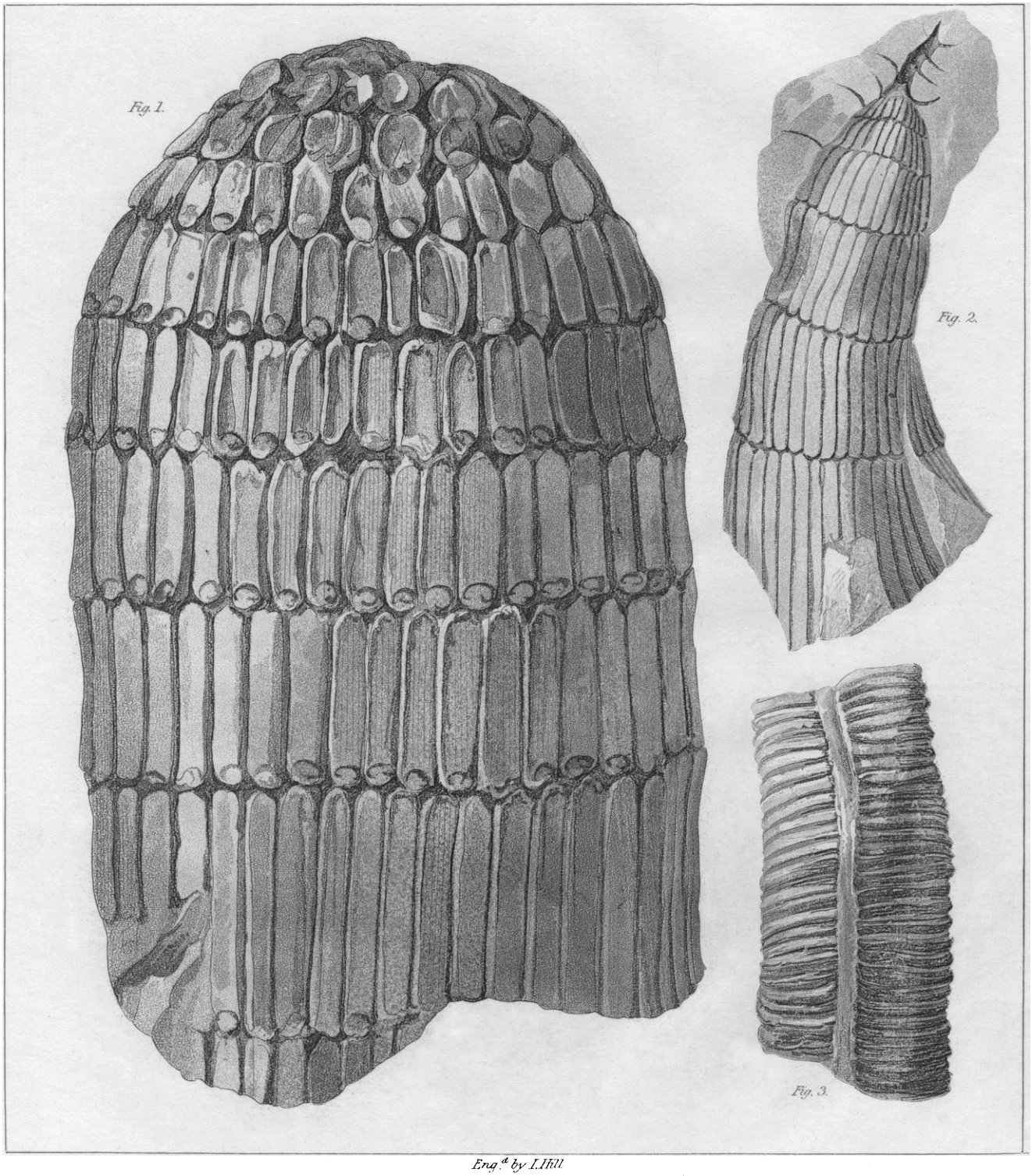


Fig. 7.

Eng.d by I. Hill

PLATE V.



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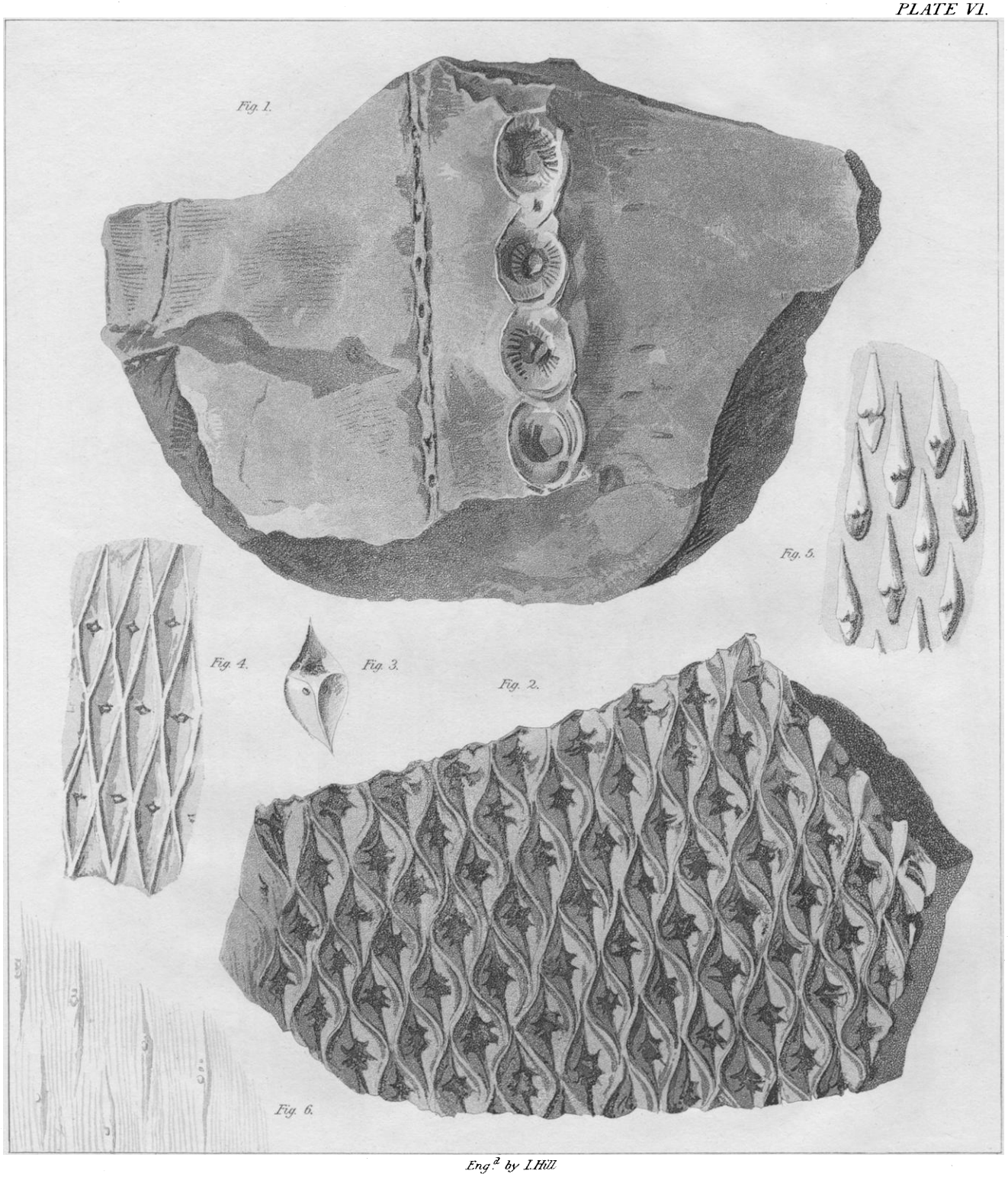

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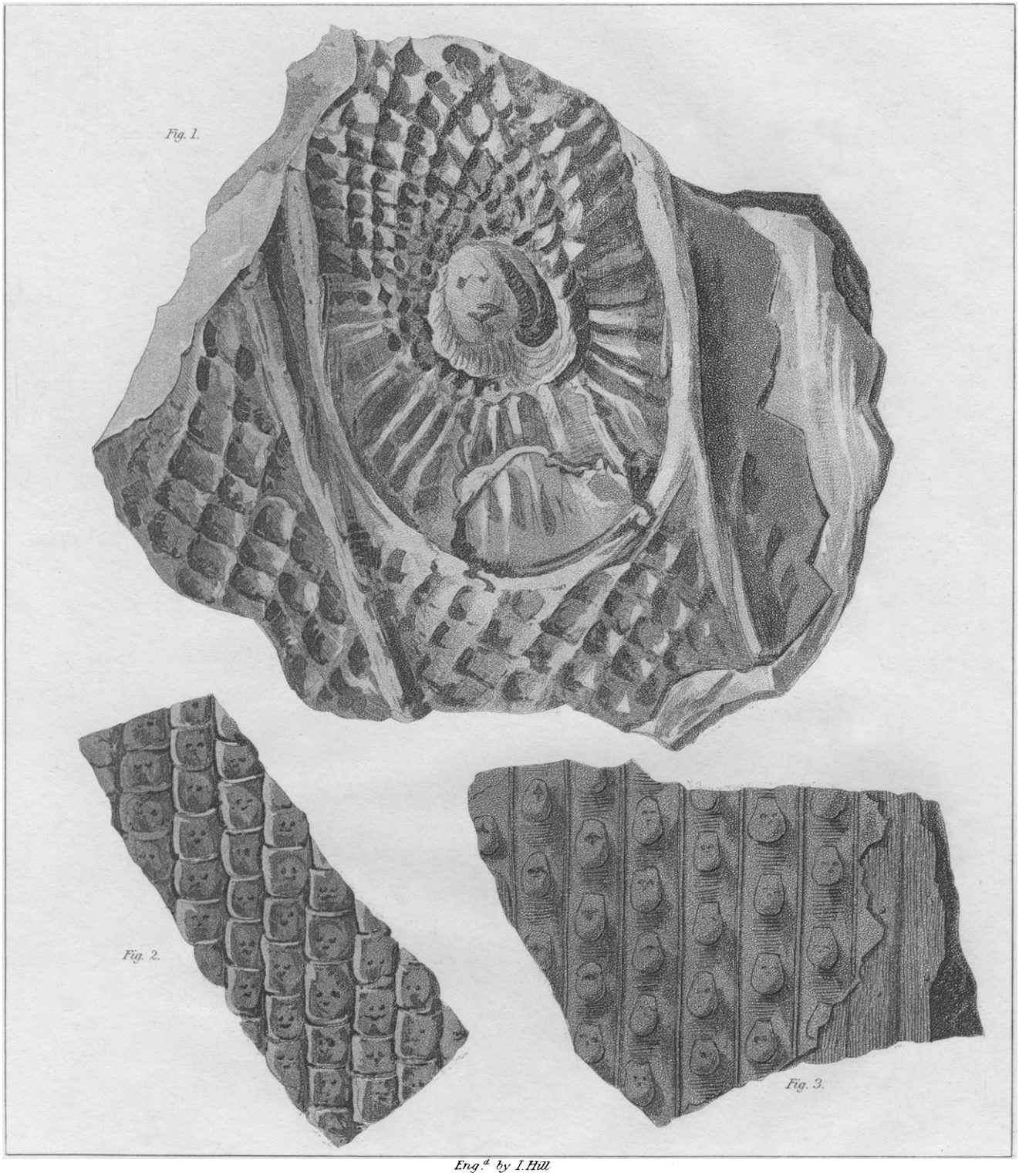

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